

10
BRIEFE IN:
TRODVCTION
TO GEOGRAPHY

CONTAINING A
DESCRIPTION OF THE
GROVNDs, AND GENERALL
PART THEREOF, VERY NE-
*cessary for young students in
that science.*

WRITTEN BY THAT LEARNED
man, M^r WILLIAM PEMBLE, Master *R*
of Arts, of Magdalen Hall in Oxford.



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A

BRIEF IN
TRODUCTION
TO GEOGRAPHY

CONTAINING A

DESCRIPTION OF THE
GROUNDS AND GENERAL
PART THEORETICAL VERY
EASY FOR THE YOUNG TO
UNDERSTAND

WRITTEN BY THAT LEARNED



WILLIAM BROWNE RICHARDSON
ESQ. F.R.S. &c.



To the Reader

Gentle Reader; I here present vnto thy view these few sheets, written by that learned man M^r William Pemble, I doubt not to call him the father, the childe fauours him so much. It hath long lay hid from thy sight, but now at length emboldned vpon thy courteous acceptance of his former labours, is lookes abroad into the world, li's but little, let not that detract any thing from it, there may lie much, though pent vp in a narrow roome; when thou reades, then iudge of it; Thus much may bee sayd: Though many haue writ of this subiect, yet this inferiour to none; thou mayst obserue in it an admirable mixture of Art and delight, so that for younger Students it may bee their introduction, for others a Remembrancer, for any not vnworthy the perusall: only, let it finde kinde entertaynement, at thy hands. Farewell.



Topline Reader

The first of these is the fact that the
 second of these is the fact that the
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A BRIEFVE INTRODVCTION
TO GEOGRAPHIE.

CHAP. I.

A generall description and diuision of Geography.



Opographie is a particular description of some small quantity of Land, such as Land measurers sett out in their plots.

Chorographie is a particular description of some Country, as of England, France, or any shire or province in them: as in the visuall and ordinary mappe.

Geography is an art or science teaching vs the generall description of the whole earth, of this especially wee are now to speake of, and also Chorography as a part vnder it conteyned: both, excellent parts of knowledge in them selues, and affoording much profit and helpe in the vnderstanding of history & other things. The parts of Geography are two,

Generall, which treateth of the nature, qualities, measure, with other generall properties of the earth.

Speciall, wherein the severall countrys and coasts of the earth are deuided and described.

Of the generall in the first place, and more at large then of the other, because it is more difficult, and hard to bee vnderstood, and yet of necessary vse, for the vnderstanding of the other. This generall tract may bee parted into fve particular heads.

- 1 of the properties and affections of the earth.
 - 2 of the parts of it in generall.
 - 3 of the Circles of it.
 - 4 of the distinction and diuision of it accordinge to
some generall conditions and qualities of it.
 - 5 of the measuringe of it.
- These in their order.

CAP. 2.

Of certaine generall properties of the earth.

IN Geography when wee name the earth wee meane not the earth taken seuerally by it selfe, without the seas and waters. But vnder one name both are comprised, as they are now mingled one with another and doe both together make vp one entire and round body. Neither doe wee diue into the bowels of the earth, and enter into consideration of the naturall qualities, which are in the substance of Earth and water, as coldnes, drinesse moisture, heauines, and the like, but wee looke only vpon the out side, contemplating the greatnesse, situation, distances, measuringe, and other such affections which appeare in the superficies of it, to the eyes of our bodies and mindes: These then of the earth and water together, rules are to bee knowne,

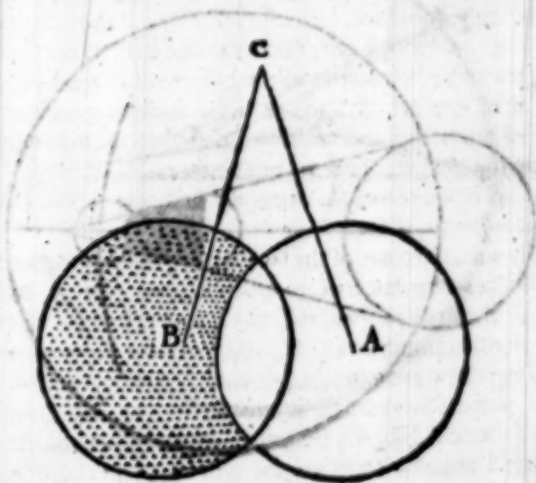
1 *The earth and the water doe make one globe, i.e., one round or sphericall body.*

The naturall place of the water is to bee aboue the earth, and soe it was in the first creation of it, compassing the earth round about as appeares Genes. 1. 9. But for the vse of it an and all other liuing creatures, God made a separation of them causing the waters to sinke downe into huge hollow channells, prepared to receaue it, that so the drie land might appeare aboue it. Norwithstanding which separation, they doe both still remaine together, not couering one another as at first, but intermingled one with another, and that soe exactly as they now make but one round body, whereas at first they

they made two. Here therefore are two points to be proued,
 1. That they are one globe. 2. that this one is round.

1 They are one globe having the same Center or middle point, and the same surface or conuexe superficies. which will appeare by these reasons.

1 Common experience. Take a lump of earth and any quantity of water, and let them both fall downe together vpon the earth from some high place, wee see that in the descent they doe not seuer, but keepe still together in one straight line, which could not bee, if the earth and water were two severall round bodies having severall centers. As for example suppose them to bee two globes and let (a) bee the Center of the earth and (b) the center of the water; sit (c) some high place above the earth hurle downe earth and water, I say the earth will part from the water in going downe and the earth will fall downe vpon (d) & the water vpon (e) but this is contrary to experience & ergo the supposition is false.



E

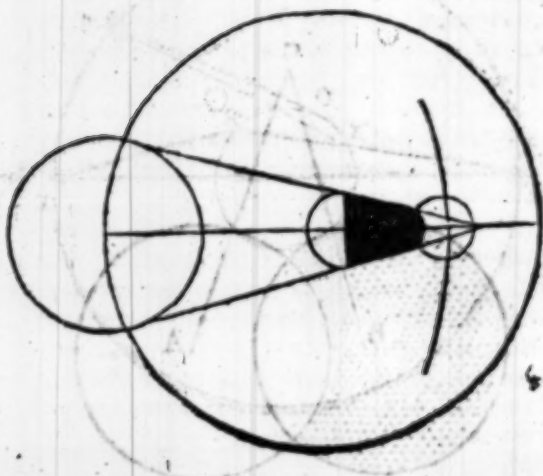
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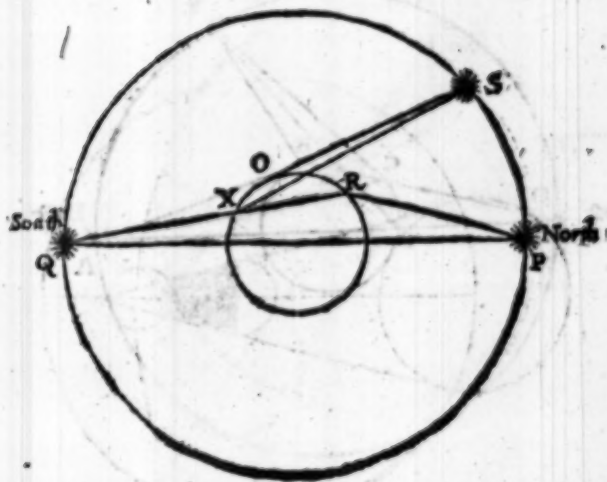
2 The shadow which in Eclipses is cast vpon the Moone by the earth and the water, is but one and not two, & therefore the body is so likewise. This will appeare in the prooffe of the next point, v. 2.

2 That both earth and water are one round body, not square, long, hollow, or of any other figure. This is proued by diuers reasons.

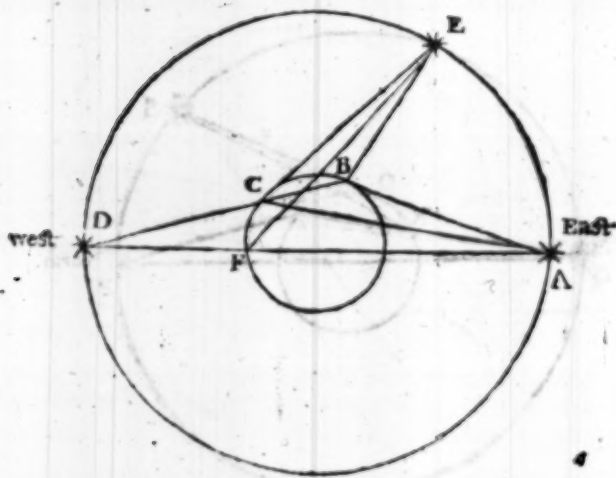
1 By Eclipses; when the earth, stands iust betweene the Sunne and the Moone, then doth the shadow of the earth falling vpon the Moone darken it wholly or in part. Now as is the fashion of the shadow, such is the figure of the body, whence it falls, but the shadow of the earth and water cast vpon the Moone is round, and also one, therefore they are round and also one body.



2. By the orderly and successiue appearing of the starres,
as men traile from North to South, or from South to North,
by sea or land: For as they goe by degrees, they discover new
starres, which they saw not before, and loose the sight of them
they did, which could not bee if the earth were not round,
As for example, let $(X.O.R.)$ the inward Circle bee the earth,
 $(Q.S.P.)$ the outward, the Heauen: they cannot see the starre
 (S) which dwell vpon the earth in (X) but if they goe North-
ward vnto (O) they may see it. If they goe farther to (R)
they may see the starre (P) but then they loose the sight of
the starre (Q) which being at (X) and (O) they might haue
sene. Because, as it appeares in the figure, the earth riseth vp
round betweene (R) and (X) .

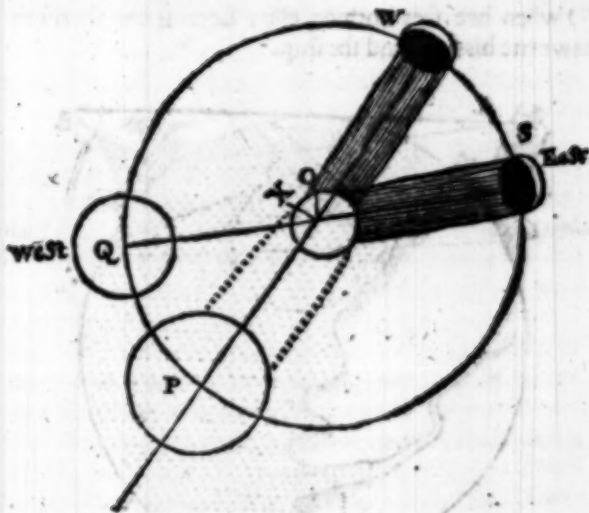


3 By the orderly and successive rising of the Sunne and starres, and settinge of the same. Which appeare not at the same time to all countryes, but vnto one after another. As for example, let $(F.C.B.)$ be the Circle of the earth, $(D.E.A.)$ the Circle of the heauen from East to west, let (A) bee the Sunne or a starre. When the Sunne (A) is vp, and shines vpon them that dwell in (B) hee is not risen to them that dwell in (C) againe when hee is risen higher and is come to (E) and so shines vpon those that dwell in (C) hee is not yet vp to them that dwell in (F) . Againe when hee settis in the West. in (D) and so is out of sight to the inhabitants in (B) hee is yet vp to them that dwell in (C) and (F) . Which shews plainly the earth is round.



4 By the different obseruations of Eclipses. One and the same Eclipse appearing sooner to the Easterly Nations then those that lye farther west. which is caused by the bulke of the earth swelling vp betweene. As for example.

Let $(X.O.)$ bee the Circle of the earth, and the greater the Circle of the heauen from East to West. Let $(P.Q.)$ bee the body of the Sunne, $(W.S.)$ of the Moone in the eclipse by reason of the earth betweene it and the Sunne. It is manifest that the inhabitants in (O) shall see the eclipse before the inhabitants in (X) by certaine houres, according as the distance betweene (X) and (O) is more or lesse. They that dwell in (O) shall see it in (S) they that dwell in (X) see it not till it come to (W) a greatdeale higher.



That

That the water is round besides the naturall weight and moisture of it, which being apt to yeeld and runne abroad, will not suffer some places to ly high, and some low, like hills, & dales, but though it be made rough and vneuen by tempest, doth presently returne to their naturall smoothnesse and euennesse: I say besides this: it is cleare by common experience; for if wee stand on the land, and see a ship goe forth to sea, by degrees wee loose the sight of it, first of the bulke then of the mast, and all. So also one the other side they that are at sea by degrees doe loose or gaine the sight of the Land: As for example.

Let (A) bee some steeple vpon the land (B) a shipp at sea: He that stands at (A) shall by little and little loose the sight of the ship, as shee goes out, & gett sight of her as shee comes in. Both first and last hee shall haue the sight of the top mast (B) when hee sees nothing else. Because the sea riseth vp betweene his sight and the ship.



These

These reasons and experiments may suffice to proue the roundnesse of the earth and water; which might bee farther demonstrated by shewing the fallshood of all other figures regular or irregular that can be given vnto it; that it is neither square, nor three-cornerd, nor Pyramidall, nor conicall on Taperwise, nor Cylindricall like a barley rowle, nor hollow like a dish, nor of any other fashion, as some haue imagined it to bee of. Wee come to this second rule.

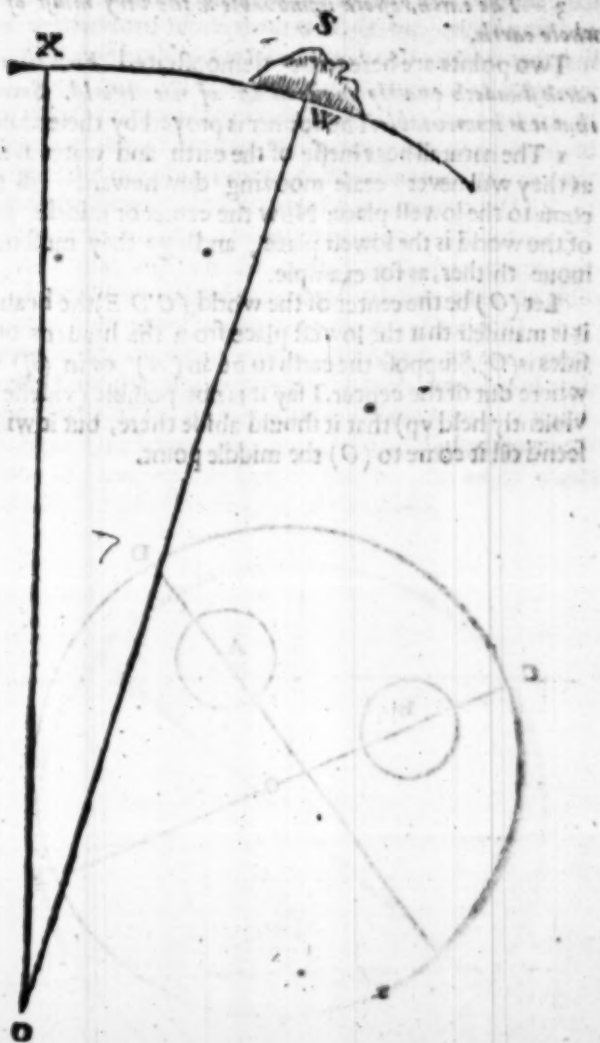
2 *The tops of the highest hills, and bottoms of the lowest vallies although in severall places they make the earth vneuen, yet being compared to the vast greatnesse of the whole, doe not at all hinder the roundnesse of it.*

Among all Geometricall figures the spheriall or the round is the most perfect, and amongst all naturall bodies the heauen is the most excellent. It was therefore good reason the most beautifull body should haue the most perfect and exquisite shape. Exact roundnesse then is not found in any body, but the Heauens; the earth is round as was showed before, but not precisely, with out all roughnes and inequality of its surface. There are hills like warts and vallies like wrinkles in a mans body; and that both for ornament and vse. Yet is there such vnformity in this varietie, as that there is no notable and sensible inequality made in the earth by Hills and vallies. No more then if you should lay a fly vpon a smooth Cartwheele, or a pinnes head vpon a greate globe. Now that this is soe appeares by Sense and Reason. By Sense thus, If wee stand on a hill or in a plaine, when wee may discerie the country round about 15. or 20. miles; wee may behold the brim or edge of the earth round about vs to bee in a manner euen and streight, euen there, where the country is very hilly, and full of mountaines. So that a farre of their height makes but a little alteration and difference from the plaine Countreys, when wee behold all together a farre of: though when wee come neere, the alteration seemes more sensible.

By reason thus, the thicknesse of halfe the earth is (as shall be shewed about 4000 miles, now the plumb height of

the highest mountaines, is not accounted aboue a mile and a halfe, or two miles at the most. Now betweene two miles and foure thousand, there is no sensible proportion, and a line that is foure thousand and two miles long, will not seeme sensibly longer then that which is foure thousand; as for example. Let (O) be the center of the earth, (XW) a part of the circle of the earth which runneth by the bottomes of the hils and superficies of chanipion and even plaines (WO) or (XO) is the semidiameter or halfe the depth of the earth. (S) is a hill rising vp aboue that plaine of the earth, (WS) is the plumb height of the hill. I say that (WS) doth not sensibly alter the length of the line (OW) ; for (WS) is but two miles. (WO) 4000 miles, and two to 4000 alters not much more, then the breadth of a pinne to the length of a pearch. So a line drawne from (O) the center to (S) the top of the hill, is in a manner all one with a line drawn to (W) the bottome of the hill.

The



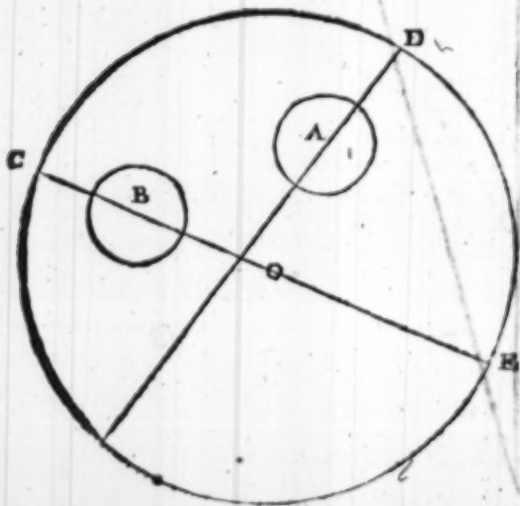
The third rule.

3 The earth resteth immovable in the very midst of the whole earth.

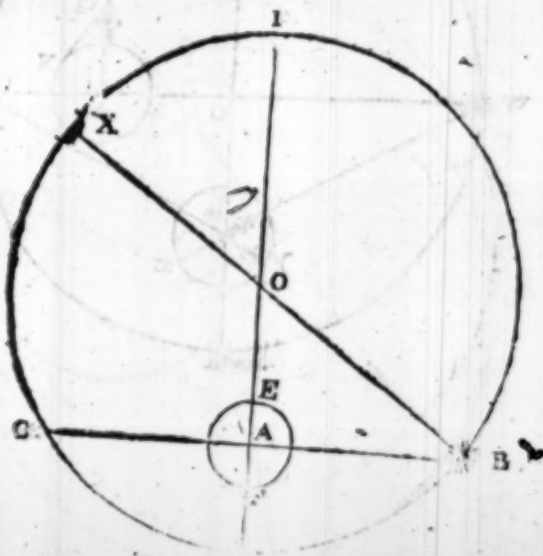
Two points are here to be demonstrated. First that the earth standeth exactly in the midst of the World. Secondly that it is immoveable. The former is proved by these reasons.

1 The naturall heaviness of the earth and water is such, as they will never cease mooving downwards till they come to the lowest place; Now the center or middle point of the world is the lowest place, and *ergo* they must needs moue thither, as for example.

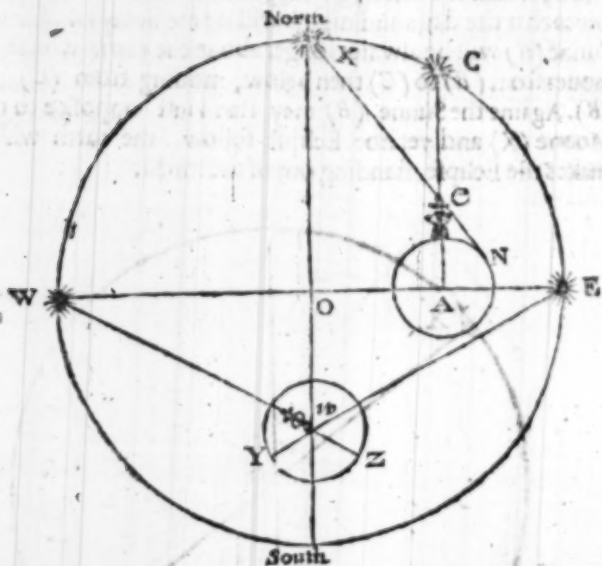
Let (O) be the center of the world, (C D E) the heauens: it is manifest that the lowest place from the heauens on all sides is (O). Suppose the earth to be in (A) or in (B) some where out of the center, I say it is not possible (vnlesse it be violently held vp) that it should abide there, but it will descend till it come to (O) the middle point.



2 If the earth stood any where but in the midst we should not see halfe the heauens about vs, as now we alway doe, neither could there be any Equinox, neither would the daies and nights lengthen and shorten in that due order and proportion in all places of the World as now they doe; againe Eclipses would never fall out but in one part of the heauens, yea the Sunne and Moone might be directly opposite one to another and yet no Eclipse follow, all which are absurd. As for example, let the center of the World be (*O*) let the earth stand in (*A*), a good way distant from the center, it is manifest that the greater halfe of the Heauens (*CIB*) will alwaies be aboute, and the lesser halfe (*EDB*) below, which is contrary to experience. Thence also it followes that the daies and nights will never be equall, for the Sunne (*B*) will be alwaies longer aboute the earth whilst he moues from (*B*) to (*C*) then below, mouing from (*C*) to (*B*). Again the Sunne (*B*) may stand iust opposite to the Moone (*X*) and yet noe Eclipse follow, the earth which makes the Eclipse, standing out of the midst.

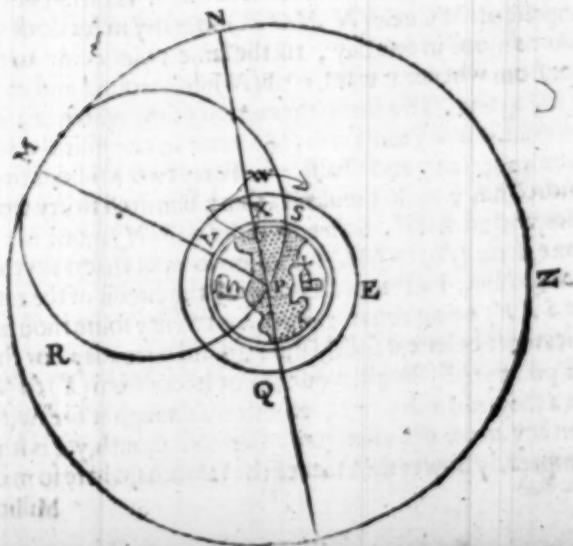


3 The shadowes of all bodies on the earth would not fall in that orderly vniformity as they now doe: for if the earth stood towards the East, the shadowes would be shortest before noone, if toward the west afternoone, if towards the North, the shadowes would still fall Northward, if towards the South, Southwards, all which experience shewes to be false. As for example, let the earth stand Eastwards in (*A*) the shadow of any body vpon the earth, as of the body vnder (*E*) will be shorter in the morning when the sunne is in (*C*), then at noone when the sunne is in (*X*). If the earth stand Southward in (*W*) the shadow of any body will alwaies fall south, as it doth in the figure (*T*) and (*Z*.)



The second thing to be proved was that the earth is immovable, where wee must vnderstand a double motion, Streight, or Circular. For the first it is cleare that with out supernaturall violence it cannot bee moued in any streight motion, that is, vpward downewarde, or toward any side; it cannot bee shoued out of his place.

For the Second, whether abiding still in his place it may not moue rounde, the question is disputed, and maintained one both sides. Some affirme it may, and doth: who thinke there is greater probabilitie the earth should moue round once a day, then that the Heauens should: by reason of the incredible swiftnesse of the heauens motion, scarce conpetible to any naturall body; and the more likely Slownesse of the earths mouing. Others deny it grounding their opinion vpon Scripture, which affirms the earth to stand fast, so as it cannot bee moued; and vpon Sence, because wee perceauie it not to moue, and lastly vpon reasons drawne from things hurled vp, and let fall vpon the earth. The arguments on both sides wil bee more easie to bee vnderstood by the figure that follows.



In this figure it is manifest, that the earth in the midst, cannot moue by any streight motion, vpward towards (*N*) or sideward toward (*M*) or any other way out of its proper place, and therefore that opinion of *Copernicus* and others, that the earth should moue round once ayeere in such a Circle as (*M P R*) is most improbable & vnreasonable. And rejected by the most.

But although it cannot moue streight, it may moue round. For though it be a marueilous great body of vnconceauable weight, yet being equally poised on euery side, there is nothing can hinder its Circular motion: As in a Globe of Lead, or any other heauy substance, though it were 40. Fadome in compasse, yet being set vpon his two Poles, it would easily bee turned round euen with a touch of ones little finger. And therefore it is concluded that this circular motion is not impossible. The probabilitie of it is thus made plaine. The whole circuit of the Heauens, wherein are the fixed Starrs is reckoned by Astronomers to bee 1017562500. that is a Thousand and seauenteene Millions of miles, five hundred sixty two thousand, and five hundred miles. Let this bee the compasse of the Circle (*N M O Z*.) So many miles doth the Heauens moue in one day, till the same point come to the place from whence it went; as till (*N*) moue round, and come to (*N*) againe. This being the motion of the whole day 24. houres, how many miles will (*N*) moue in one houre? it will moue 42398437 and a halfe. *i. e.* Forty two Millions three hundred ninety eight thousand, foure hundred thirty seven miles and an halfe. So many miles will (*N*) moue in one houre, from (*N*) to (*M*.) A motion so swift that it is vtterly incredible. Farre more likely it is, the circuit of the earth (*A S X V*) being about 24000. *i. e.* twenty foure thousand miles more or lesse, it should moue round once a day. For then one point as (*X*) should moue in one houre from (*X*) to (*V*) but a thousand miles, which motion, although it bee swifter then any arrow or bullet from a Cannons mouth, yet is it incomparably slower then that of the Heauens, where so many
Millions

Millions are posted ouer in an houre.

Now for the saluing of all the celestiall Phenomena, or appearances, the truth is the same, if wee suppose the earth to moue, as if wee belecue it to stand still. The risinge of the Sunne and Starres, the motions of all the Planets, will keepe Correspondence that now. Nor neede wee feare logging, or that steeles and towers would totter downe, for the motion is regular, and steady without rubbes, and knocks. As if you turne a globe about, it will goe steadily, and a fly will set fast vpon it, though you moue it apace. Besides the whole body the ayre is carryed about with the whirling of the earth, so that the earth will make noe winde, as it turnes swiftly about; as a wheele will, if it bee turned apace.

Notwithstanding all this, most are of another opinion, that the earth standeth still without all motion, rest rather besittinge so heauy and dull a body then motion. The maine reason brought to establish it is this. Let a stone bee throwne downe out of the ayre from (*W*;) if the earth stand still, it is manifest it will fall vpon (*X*) iust vnder it; as wee see it doth by common experience, a stone will fall downe from any height vpon the place wee aymed at, but let the earth moue, the stone will not light vpon (*X*;) but some where else as one (*S*;) for (*X*) will bee moued away, and gone to (*V*.)

So againe let two peices of ordinance that will shoote at equall distance bee discharged one iust towards the East; the other towards the West; if the earth moue (as they say it doth) towards the West, the bullet that is discharged Eastward will fly farther then that Westward. For by the contrary motion of the earth hee will gaine ground. But experience hath proued this to bee false, shewing that the bullets, will both fly at equall distance.

To salue this, answere is made that the earth by its swift motion carries with it and that steadily not only all bodies resting or moueing vpon it, but also the whole Sphære of Aire (*W E Q*) with all things whatsoever that are moued in it naturally or violently, as clouds, birds, stones hurled vpon
C
downe,

downe, arrowes, bullets, and such like things violently shott forth as may appeare in the figure.

The fourth rule.

4 The earth, though it bee of exceeding greate quantity being considered in it selfe, yet being compared to the Heauens, especially the higher sphæres, is of noe notable bignes, but may be accounted as a point or pricke in the midst of the world.

That the earth is noe bigger then a point or pinns head in comparison of the highest heauens will easily appeare vnto vs, by these reasons.

1 The starres which are many times bigger then the earth, seeme yet to vs to bee noe bigger then a greate pinns head, or such like quantity; therefore much lesse shall the earth appeare to bee of any sensible magnitude.

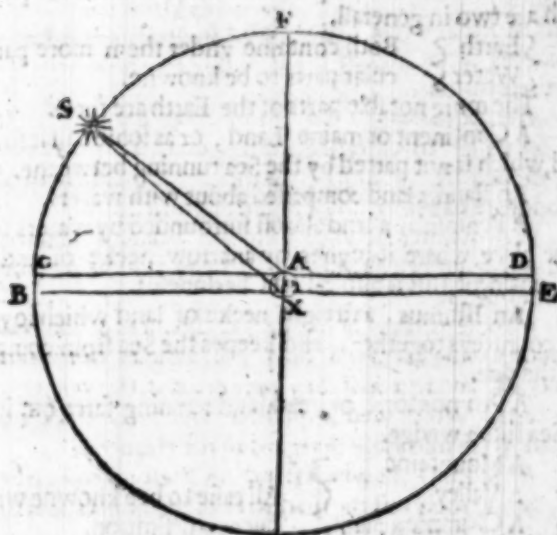
2 Wee alwaies beholde halfe the heauens about vs, which could nor bee if the earth had any sensible proportion to the heauen.

3 All obseruations of heights and distances of the celestiall bodies, which are made on the superficies of the earth, are as exact, and true, as if they were made in the very center of the earth. Which were impossible, vnlesse the thickness of the earth were insensible in regard of the Heauens.

4 All Sunn Dials which stand on the superficies of the earth, doe as truly cast the shadowes of the houres, as if they stood in the Center. As for example.

The starre (*S*) appeares like a point or pricke to them that dwell in (*A*) wherefore the earth (*OX*) will appeare much lesse to the sight of him that should behold it from (*S*), nay it would not bee seene at all. Againe halfe the Heauens (*BFE*) are alwaies seene to thē that dwell in (*A*) wanting some two minutes, betwene (*ED*) and (*BC*) which difference is altogether insensible. Againe if wee obserue the height of the starre (*S*) about the Horizon (*BE*) it will bee all one namely (*BS*) whether wee obserue it in the topp of the earth in (*A*) or in the middle in (*O*). For, (*A*) and (*O*) are so little distant

stant one from another, that (AS) and (OS) will bee parallel lines, and bee esteemed but as one line. The fourth reason concerning Dials, is cleare by the framing and construction of them: wherein either the lower end of the Cocke (or Gnomon) whe reat all the houre lines meet, or the vpper end and knobb (as in many Dials) is supposed to bee the Center of the earth.

C₃

CAP. 3

CAP. 3.

Of the parts of the terrestrial
Globe.

THe properties of the earthly Globe haue beene handled in the former chapter wee come now to the parts, which are two in generall.

{ Earth } Both containe vnder them more parti-
{ Water } cular parts to be knowne.

The more notable parts of the Earth are these.

1 A Continent or maine Land, or as some call it firme Land, which is not parted by the Sea running betweene.

2 An Iland, a land compassed about with waters.

3 A Peninsula, a land almost surrounded by waters saue at one place, where it ioynes by anarrow necke of land to the Continent; this is also called Chersonesus.

4 An Isthmus, a streight necke of land which ioynes two countreys together, and keepe the Sea from compassing the one.

5 A Promontorie or head land running farre out into the Sea like a wedge.

6 A Mountaine

7 A Valley

8 A Champion plain

9 A Wood

} All easie to bee knowne without any definition.

The more notable parts of the Water are these

1 *Mare* the Sea, or Ocean, which is the gathering together of all waters.

2 *Fretum* a streight or narrow sea running betweene two lands.

3 *Sinus* a Creeke, Gulfe, or Bay, when the sea runnes vp into the bosome of the land by a narrow enterance but openeth it broader when it is within; if it bee very litell it is called a Hauen, *Portus*.

4 *Lacus*

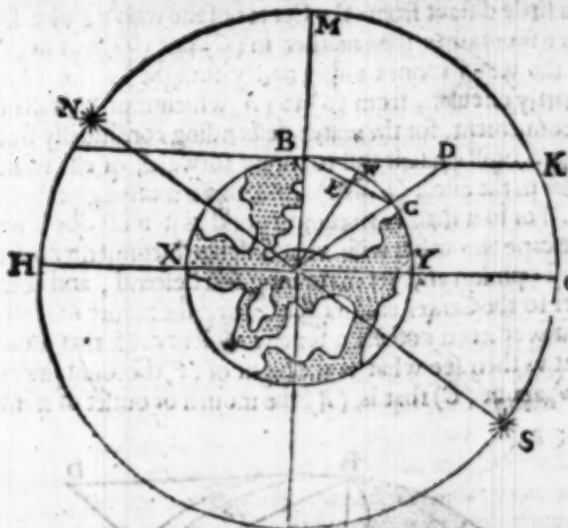
4 *Lacus* a Lake, a little sea with in the land hauing ri-
uers running into it, or out of it, or both. If it hath neither it
is calld *Stagnum* a standing Poole, also *Palus*; a sennie.

5 *Fluvius* a River, which from the pleasantness is also
called *Amnis*; from the smallness of it *Rivus*.

Now concerning these parts diuers questions are moued;
whether there bee more Sea or Land? whether the sea would
naturally ouerflow the land, as it did in the first creation,
were it not withheld within his banks by diuine power?
whether the deepenes of the Sea, doth exceede the height of
the mountaines? whether mountaines were before the flood?
what is the height of the highest hilles? whether Lands came
since the flood? what is the cause of the Ebbing and flowing
of the Sea? what is the originall of springs and riuers? what
manner of motion the running of the riuers is? with such like,
whereof some belong not so properly to this science of Geo-
graphy as to others. Wee speake onely a word or two of the
last, & proceed. The question is whether the motion of the
riuers bee streight, or Circular. The doubts on both sides will
best appeare by a figure first drawne: wherein, Let (*HMO*)
be the Meridian of *Alexandria* in *Egypt*, or of the Mouth
of *Nilus* and answerable to the meridian of the Heauens. An-
other in the Earth (*XY*). Let (*B*) bee the mouth of *Ni-
lus*, and (*C*) the fountaine and head of it. Now the mouth of
Nilus, where it runnes into the mediterranean Sea, is placed
by geographers in the 31. degree of the North latitud; & the
head of *Nilus* where it riseth is placed by *Ptolomaeus* in 11.
degree of the South latitud, but by latter & more exact geo-
graphers in the 14. degree of the Southern latitud, so that the
distance betweene the founts & *Ostia*, i.e. betweene (*C*) and
(*B*) is 45. degrees of a great Circle, which after the vsual ac-
count makes 2700. one eight part of the earths compasse.
The question now is, whether the runninge from (*C*) to (*B*)
runne continually downward in a streight line; or circularly
in a crooked line. If it runne in a streight line, as is most a-
greeable to the nature of the water it must moue either by

the line (*C E B*) or by the line (*D B*). By the line (*C E B*) it cannot move: for when it is come to (*E*.) it will stand still. Because from (*E*) to (*B*) it must moue vpward, if it moue at all, which is contrary to the nature of water. If therefore it moue by a streight line it can bee noe other, but (*B D*.) and so from (*D*) to (*B*) it shall continually descend; for of all places betweene (*D*.) & (*B*) (*B*) is the nearest to (*A*.) But then the fountaine must not bee in (*B*) but higher in (*D*) which seemes altogether improbable or impossible. For first the line (*A D*) would bee notably and sensibly longer then the line (*A B*.) For the compasse of the earth being about 24000. Miles, and the semidiameter (*A B*.) or (*A C*) 3828. miles the line (*C D*.) would bee 2581. miles, which cannot bee true, if as wee haue proued before, the earth bee round, and that the highest hills make noe sensible inequality. A gaine they that dwell in (*D*) should see the North Pole starre (*N*) as well as they that dwell in (*B*.) which also is false. So then the riuer cannot runne either by (*E B*) or (*D B*); Runnes it then circularly by the line (*C W E*)? This seemes probable, and the rather because heereby a reason of the originall of Rivers might more easily bee giuen: For the fountaines (*C*) lying euen with the superficies of the Sea, the water may easily passe through the hollowes of the earth, and breake out at (*C*) without ascendinge. But here also are some difficulties: for first wee find by experience that the fountaines of most riuers, and those greate ones too, lye sensibly higher then the plaine surface of the Sea. Againe, if the riuer moue directly round, what should bee the cause that begins and continues this motion? It is a motion besides the nature of the water, and therefore violent, what should driue it forward from the Sea to (*C*.) and from (*C*) to (*E*?) when the water is at (*C*.) or (*W*.) it is as neere to the Center (*A*) as when it is at (*B*.) and therefore it should seeme with more liklyhood it would stand still; for why should it strue to goe further, seeing where it is, it is as neare to the Center as whither it runnes. Or if some violence doe driue it from (*C*.) towards (*W*)

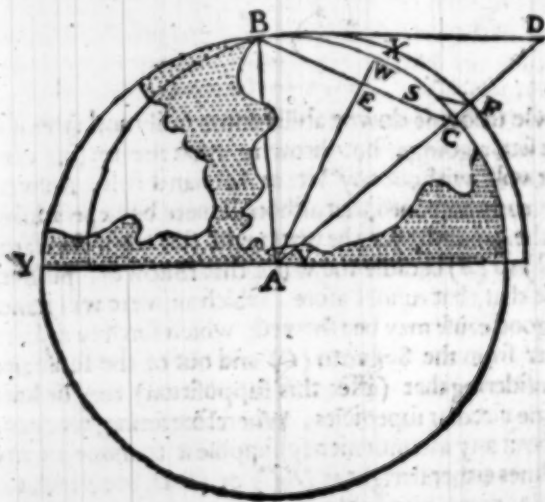
(W.) yet (as it is the nature of violent motions) the further it goes the slower it will runne, till in the end it stand still, if there bee noe aduantage of ground to helpe it forward.



As a bowle throwne downe a hill runnes easily and farre. if it once bee sett a going; but throwne vpon the ice (an even place) it will without any lett at last stand still, Answer may bee made hereunto, that although there bee noe aduantage of the ground, yet the water will still move forward from (C) to (B) because the water that followes, pulseth forward that, that runnes afore. which answer will stand, when a good cause may bee shewed, which forcibly driuerth the water from the Sea vnto (C) and out of the fountaine (C); considering that (after this supposition) they lie both in the same circular superficies. Wherefore seeing, wee cannot without any inconueniency suppose it to moue by any of these lines either streight as (B C) or (B D,) or circular as (B W C) let vs enquire farther.

The . . .

The most likely opinion is, that the motion of the water is mixt neither directly freight, or circular, but partly one, partly the other. Or if it be circular, it is in a circle whose center is a little distant from the Center of the whole globe. Let vs place fountaines then neither in (C) nor (D) but in (F) I say the water runnes either partly freight by the (FS) and partly circular, from (S) to (B) which motion will not be inconvenient, for the water descending continually from (F) to (S) will cause it still to runne forward; or else wholly circular in the circle (F X B.) And this is most agreeable to truth. For so it shall both runne round as it must doe if wee will escape the otherwise vnauoidable inconueniences of the first opinion and yet in running still descend, and come neerer to the Center, as is most befitting the nature of water, so that wee need not seeke for any violent cause that moues it. Let vs then see what is the hight of (F) the fountaines of *Nilus*, above (C) that is (B) the mouth or outlet of it into



the Sea. The vsuall allowance in watercourses is one foot in descent for 100. foot in running, but if this bee thought to much because water will runne awaie vpon any inequality of ground, for euery 100. foote allow one for descent, & so much we may with reason, in regard of the swiftnes of many riuers, yea the most, which in many places runnes headlong, in all places very swiftly (especially *Nilus* whose cataracts or downefalls are notable) which cannot bee without some notable decliuitie of the ground. Thus then the whole course of *Nilus* being 1700. miles from (F) to (B) the perpendicular or plumb descent of it (CF) will be 5. miles. And so high shall the fountaine stand aboue the mouth, and the surface of the plaine Land (for riuers commonly arise at foot of hills) which is (BXF) swell vp aboue the surface of the Sea (BWC) or (BT) which height of the Land aboue the Sea although it bee greater then is the height of the highest mountains aboue the plaine Land, yet it is nothing in comparison of the whole Earth. And this being granted (as with most probabilitie of reason it may) it will appeare that God in the beginning of the world imposed noe perpetuall violence vpon nature, in gathering together, the waters into one place, and being so gathered in keeping them from running backe to cover the earth. At the first so soone as those hollow channells were prepared, the water did naturally slide downe into them, and out of them without miraculous power they cannot returne. For if the sea (BT) should overflow the land towards (F) the water must ascend in running from (B) to (F) which is contrary to its nature. Certainly the midland countries, whence springs of great riuers vsuall arise, doe ly so high, that the sea cannot naturally overflow them. For as for that opinion that the water of the sea in the middle lies on a heape higher then the water that is by the shore; and so that it is a harder matter to saile out of a Haven to seaward, then to come in) because they goe vpward; this is an empty speculation contray to experience, and the grounds of nature it selfe, as might easily be

shewed. All the difficulty that is in this opinion, is to give a reason how the waters mount vp to (F.) and whence the water comes that should flow out of so high a place of the earth, wherein I thinke as in many other secrets of nature we must content our selues with ignorance, seeing so many vaine conjectures haue taken no better successe.

CAP. 4.

Of the circles of the earth.

IN a round body as the earth is, there can be no distinction of parts, & places, without the helpe of some lines drawen or imagined to be drawen vpon it. Now though there are not, nor can be any circles truly drawen vpon the earth, yet because there is a good ground in nature and reason of things for them, we must imagine them to be drawen vpon the earth, as truly as we see them described vpon a Globe or in a plaine paper. Further this must be noted, that all circles on the earth haue the like opposite vnto them conceaved to be the Heavens, vnder which they are directly scituated. Thus knowen, the circles that wee are to take the speciall notice of are of two sorts,

Greater and
Lesser.

The greater circles are those which diuide this earthly globe into equall halfes or Hemispheres.

The lesser are those which diuide it into two vnequall parts, one bigger, another lesse.

Of the former sort there are foure, the

- 1 Equator.
- 2 Meridian.
- 3 Horizon.
- 4 Zodiack, or Eclipticke.

1 The Equator or Equinoctiall line, is a line drawen in the midst of the earth, from East to West, which compasseth it as a girle doth a mans body, and divideth it into two equall

equal parts, one on the North side, the other on the South. The two points in the earth that are every way farthest distant from it North, & South are called the Poles of the earth which doe directly stand vnder the two like points in the Heaven, so called because the Heaven turnes about vpon them, as the Earth doth in a Globe that's set in a frame. This circle is of the first & principall note and vse in Geography, because all measurings for distances of places and quarters of the Earth are reckoned in it, or from it. It is called the Equinoctiall, because when the Sunne in the Heavens comes to be directly over that circle in the earth, the daies & nights are of equal length in all parts of the world. Mariners call it by a kind of excellency, *The line*. Vpon the Globe it is easily discerned being drawn bigger then any other circles from East to West, and with small divisions.

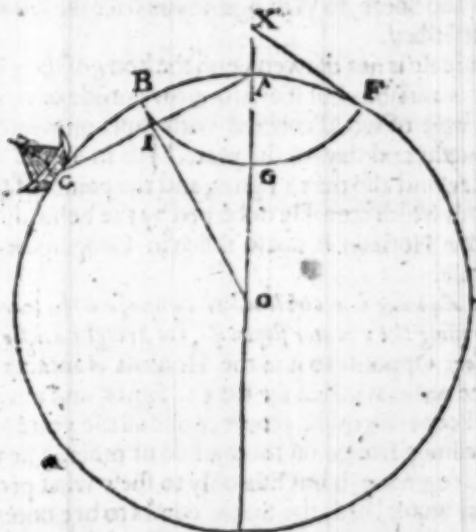
2 *The Meridian, is a line that is drawn quite crosse the Equinoctiall, and passeth through the Poles of the Earth, going directly North and South.* It is called the Meridian, because when the Sunne stands just over that circle it is *Meridies* i. d. noone day. It may be conceaued thus, at noone day, when it is just twelue a clocke, turne your face towards the South, and then imagine with your selfe two circles drawn, one in the Heavens, passing from the North iust over your head through the body of the Sunne downe to the South, and so round vnder the earth vpon againe to the North Pole. Another vpon the surface of the earth passing through your feete just vnder the Sunne, and so compassing the earth round till it meete at your feete againe, and these are Meridians answering one to another. Now the Meridian is not one only, as was the Equinoctiall, but many still varying according to the place wherein you are, as for example. At *London* there is one Meridian, at *Oxford* another, at *Brissow* another, & so along Eastward or Westward. For it is noone at *London* sooner then at *Oxford*, and at *Oxford* sooner then at *Brissow*. Vpon the globe there are many drawn, all which passe through the poles, and goe

North and South, but there is one more remarkable then the rest, drawen broad with small divisions, which runneth through the Canary Ilands, or through the Ilands of *Azores* Westward of *Spaine*, which is counted the first Meridian in regard of reckoning and measuring of distances of places one from another; for otherwise there is neither first nor last in the round earth. But some place must bee appointed where to beginne the account: and those Ilands haue bene thought fittest, because no part of the World that lay westward was knowne to the Ancients further then that: and as they began to reckon there, we follow them. This circle is called in greeke *Μεσημβριδε*.

- 3 The Horizon is twofold { Sensible or appearing.
Intelligible or true.

The Sensible or appearing Horizon is the space of the earth so farre as in an open plaine, or vpon some Hill a man may see round about him. The brim or edge of the earth further then which you cannot see, that is the Horizon, or as some call it the Finitor. Because finet or terminat visum, it sets the limits or bounds to your sight, beyond which nothing can bee seene vpon the earth. This is greater or lesser, according as the height of the eye aboue the plaine superficies of the earth, is more or lesse. The most exact triall hereof is at Sea, where there are no mountaines nor any vnequall risings of the water to hinder the sight, as there are at land. For example let $(C B A F)$ be the superficies of the Sea and let a mans eye bee placed in (X) aboue the Sea; as the eye stands higher or lower so will the distance seene be more or lesse, as if the height of $(X A)$ be 6 foot which is ordinary the height of a man, the eye looking from (X) to (B) shall see 2 miles and 3 quarters, if (X) be 20 foote high $(B A)$ will bee five miles, if 40 foote 7 miles, if 50 foote 8 miles. So that from the mast of a ship 50 foote high, a man may see round about at sea 8 miles every way, toward $(B G)$ and (F) . So farre may the water it selfe be seene, but any high thing on the water may be seene farther, 16, or 20 miles according as the height

height is, as the ship at (C) may be seene from (X) as far more as it is from (A) to (B). There can be therefore no certaine quantity and space set downe for this sensible Horizon, which continually variēs according to the height of the eye about the plaine ground or sea. This Horizon is not at all painted on the globe nor can be.



The intelligible or true Horizon is a line which girts the earth round in the midst, and divides it into two equal parts or Hemispheres the uppermost upon the the top & middale point whereof wee dwell, and that which is under vs. Opposite to this in the Heavens is another Horizon, which likewise cuts the Heaven into two Hemispheres, the vpper and the lower. Aboue which circle when any starre or the Sunne is moued, it then riseth vnto vs, and setteth vnto those that dwell opposite vnto vs, and so on the contrary, you may conceiue it best thus, if standing vpon a hill, or some open place, where you may perfectly see the setting of the Sunne, you marke

when the Sun is halfe gone out of your sight, you may perceiue the body of the Sunne cut in two, as it were by a line, going along through it; the halfe about is yet scene, that vnderneath is gone out of your sight. This line is but a peece of the Horizon, which if you conceiue to be drawn vpward about the World from the West to the North, and so by East and South, to West againe you haue the whole Horizon described.

This circle is not drawn vpon the body of the globe, because it is variable; but stands one the outside of it, being a broad circle of wood couered with paper on which are sett the moneths and days of the yeare, both in the old and new Calender, and also the 12 signes, and the points of the compasse. All which are easily discerned by the beholdinge. The vse of this Horizon is not so much in Geographic as in Astronomic.

The Zodiacke is a circle which compasseth the earth like a belt, crossing the equator slopewise, not streight as the Meridians doe. Opposite to it in the Heauens is another circle of the same name, wherein are the 12. signes, and in which the Sunne keepes his owne proper course all the yeare long, neuer declining from it on the one side or other. The vse hereof in Geography is but litle only to shew what people they are ouer whose heads the Sunne comes to bee once or twice a yeare; who are all those that dwell within 23. degrees of the Equator; for so much is the declination, or sloping of the Zodiacke. This circle is also called the Eclipticke line, because when the Sunne and Moone stand both in this circle opposite each to other, then there happens an Eclipse of the Sunne or Moone, vpon a globe it is easily discerned, by the sloping of it from the Equator, and the diuisions of it into 12. parts, and euery of those 12. into 30. degrees.

These are the greater circles: the lesser follow; which are all of one nature, and are called by one generall name: sc. Parallels, because they are so drawn on each side of the Equator, as they are equidistant vnto it euery way. Many of this kinde are drawn

drawne vpon the globe (as is easie to bee seene) and may bee conceaued to bee drawne vpon the earth: but there are only two sorts cheifely to bee marked: namely the

} Tropickes and the }
} Polar circles. }

The tropickes are two, parallel circles distant on each side of the Equator 23. degrees shewing the farthest bounds of the Sunns declination North or South from the Equator, or the midst of heauen. And therefore they are called tropickes a *τρίωδας* *vertendo*, because when the Sunne comes ouer these lines, hee either turns away from vs, as in the Summer, or turns toward vs againe as in the winter: There are then two of the *n* vid.

1 The Tropicke of Cancer which lies on the North side of the Equator, to which when the Sunne comes, it makes the longest day in Summer.

2 The Tropicke of Capricorne, lying Southward of the Equator, to which when the Sunne comes, it makes the shortest day in winter.

The Polar circles are two parallels drawne by the poles of the Zodiacke compassinge about the poles of the world, being distant from them euery way 23 degrees. These are two.

1 The Articke Circle that compasseth about the North Pole: it is so called because that in the Heauens (where vnto this in the earth lies opposite) runs through the constellation of the great Beare, which in greeke is called *αρκτος*.

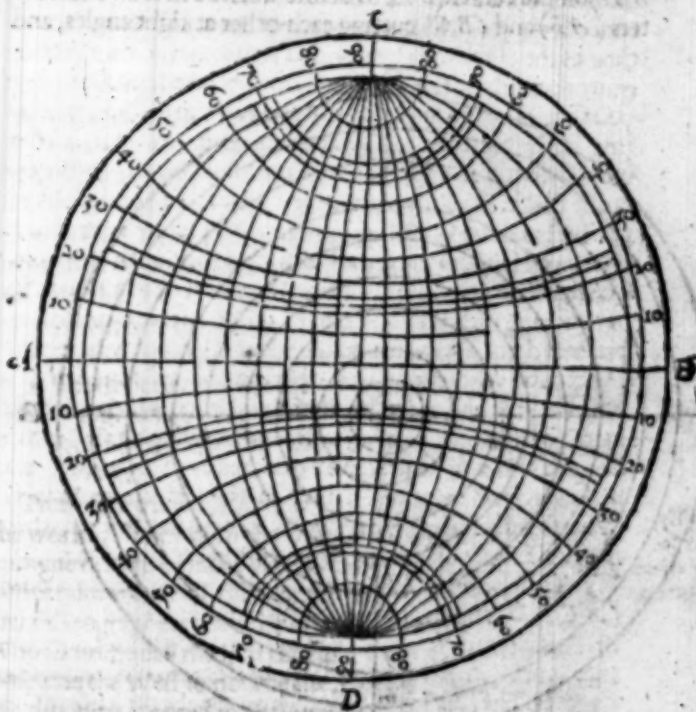
2 The Antarcticke circle that compasseth about the South Pole, & is placed opposite vnto the former. All these with the former are easily known vpon the Globe by these descriptions, & names vsually added vnto the. But because maps are of an easier price, & more common vse then Globes, it will be needfull to shew how all these circles, which are drawne most naturally vpon a round Globe, may also as truly, and profitably for knowledge and vse be described vpon a plaine paper. Whereby we shall vnderstand the reason of those lines which we see in the vsuall Mapps of the world, both how they are drawen

drawne, and wherefore they serue. Vnderstand therefore, that in laying downe the globe vpon a plaine paper, you must imagine the globe to be cut in two halfes through the midst, and so to be pressed downe flat to the paper; as if you should take a hollow dish, and with your hand squeeze the bottom down, till it lie flat vpon a bord, or any other plaine thing: for then will those circles that before were of equall distance, runne closer together towards the midst. After this conceit, vniuersall Maps are made of two fashions, according as the globe may be devided two waies, either cutting quite through by the meridian from North to South, as if you should cut an apple by the eye and the stalke, or cutting it through the Equinoctiall, East and West, as one would divide an apple through the midst, betwene the eye & the stalke. The former makes two faces, or hemispheres, the East and the West hemisphære. The latter makes likewise two Hemispheres, the North and the South. Both suppositions are good, and besitting the nature of the globe: for as touching such vniuersall maps, wherein the world is represented not in two round faces, but all in one square plot, the ground wherevpon such descriptions are founded, is lesse naturall and agreeable to the globe, for it supposeth the earth to be like a Cylinder (or role of bowling allies) which imagination, vlesse it be well qualified, is vtterly false, and makes all such mappes faulty in the scituation of places. Wherefore omitting this, we will shew the description of the two former only, both which are easie to be done.

Of this Hypothesis see Wrights errors of navigation.

I To describe an Equinoctiall planisphære, draw a circle ($ACBD$) and inscribe in it two diameters (AB) & (CD) cutting each other at right angles, and the whole circle into foure quadrants: each whereof deuide into 90. parts, or degrees. The line (AB) doth fitly represent halfe of the Equator, as the line (CD) in which the points (C) & (D) are the two poles, halfe of the Meridian: for these circles the eye being in a perpendicular line from the point of concurrence (as in this projection it is supposed) must needs
 appeare

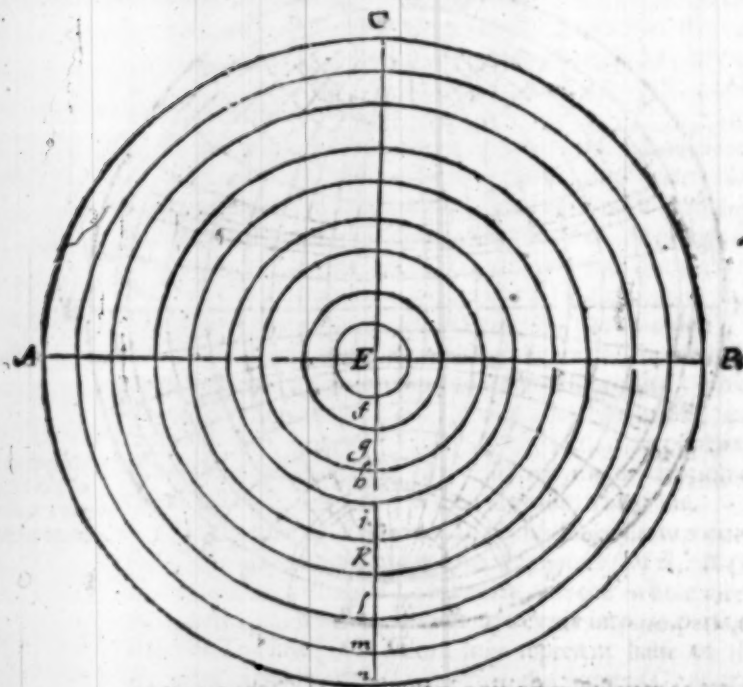
appeare streight. To draw the other, which will appeare crooked, doe thus. Lie a rule from the Pole (C) to every tenth or fift degree of the halfe circle (ADB) noting in the Equator (AB) every intersection of it and the rule. The like doe from the point (B) to the semicircle (CAD) noting also the intersections in the Meridian (CD) Then the diameters (CB) and (AB) being drawne out at both ends,



as farre as may suffice, finding in the line (DC) the center of the tenth division from (A) to (C) and from (B) to (C), & of the first point of intersection noted in the meridian from the Equator towards (C) by a way familiar to Geometricians

cians connect the three points, and you have the parallel of 10. degrees from the Equator: the like must be done in drawing the other parallels on either side, the Equator; as also in drawing the Meridians from centers found in the line (*AB*) in like manner continued. All which is illustrated by the following diagram.

2 To describe a Polar Planisphere, draw a circle (*ACBD*) on the center (*E*) & as before, inscribe in it two diameters (*AB*) and (*BC*) cutting each other at right angles, and



the circle into four quadrants. Each quadrant being divided into 90. parts, draw from every 5th or 10th of those parts a diameter to the opposite point: these lines all concurring in
The

the center (*E*) being the pole, are as so many Meridians. Next, hauing cutt the halfe of any one of the former diameters into 9 parts, as (*ED*) in the points (*F G H I K L M N*) draw on the center (*E*) so many circles and these represent the parallels of the Globe, being also here true parallels.

CAP. 5.

Of diuers Distinctions, and Diuisions
of the earth.

NExt after the Circles of the Earth, wee may not vnfitly handle the seuerall Diuisions and distinctions which geographers make of the parts, and inhabitants of the earth, These are many, but wee will briefly runne them ouer.

The first and most plaine is by the Coasts of the Hea- uens, and rising, and Setting of the Sunne, so it is distinguish- ed into the

East where the Sunne riseth. *Oriens, Ortus, ἀνατολή.*

West where the Sunne goeth downe. *occidens.*

North: betweene both fromwards the Sunne at Noone.

Septentrio.

South: betweene both towards the Sun at Noone. *Me- ridies.*

These foure are called the cheife or Cardinall quarters of the world. They with the others betweene them are easily knowne but are of more vse to Mariners then to vs, Wee may rather take notice of those other names which by Astrono- mers Geographers Diuines and Poets are giuen vnto them. Who sometime call the East the right hand part of the world, sometime the West, sometime the North, & sometime South. the diuersity is noted in these verses,

Ad Boream terra. Sed Cæli mensur ad Austrum.

Præter Dei exortum, uidet occasum, Poeta.

That is Geographers looke to the North, Astronomers to the South.

Priests turne them to the East, & Poets to the West.

This serves for vnderstanding of Authors, wherein any mention is made of the right or left part of the World; if for example he be a poet, he means the South by the right hand, the North by the left: because a poet turns his face to the West, and so reckons the quarters of Heaven and Earth.

2 The second distinction is by the notable differences of heat and cold, that are observed on the earth, this is the the division of the Earth by Zones or Girdles, which are parts of the Earth, wherein heat and cold doe remarkably increase or decrease. Those Zones are 5.

1 The hot or burning Zone (*Zona torrida*) which contains all that space of earth, that lieth betwene the two Torpicks, supposed heretofore (but falsely as after experience hath shewed) to be inhabitable by reason of heat, the Sunne continually lying ouer some part of it.

2. 3 The temperate Zones wherein neither heat nor cold is extreame but moderate: these are two, one on the North side of the Equator betwene the Arcticke circle, and the Torpicke of Cancer, another on the South side betwene the Torpicke of Capricorne, and the Antarticke circle.

4. 5 The cold, or Frozen Zones, wherein cold for the most part is greater then the heat, these likewise are two, one in the North, betwene the Arcticke circle, and the North Pole, another on the South betwene the Antartick circle and the South Pole. These of all parts of the earth are worst inhabited, according as extremity of cold is alwaies a greater enemy to mans body, then extremity of heat.

3 The third distinction is by the shadowes, which bodies doe cast vpon the earth, iust at nooneday; for these doe not alwaies fall one way but diuersly according to their diuers situation vpon the Earth. Now in respect of the shadowes of mens bodies, the inhabitants of the earth are diuided into the

1 *Amphiscij* (*Amphiscenae*) whose shadow at noone day fall both waies, *sc.* to the North when the Sunne is Southward of them, & to the South when the Sunne is Northward,

Longitud of a place, is the distance of it from the first Meridian going through the Canary Ilands, Eastward. Whereby wee know how farre one place lies East or West from another.

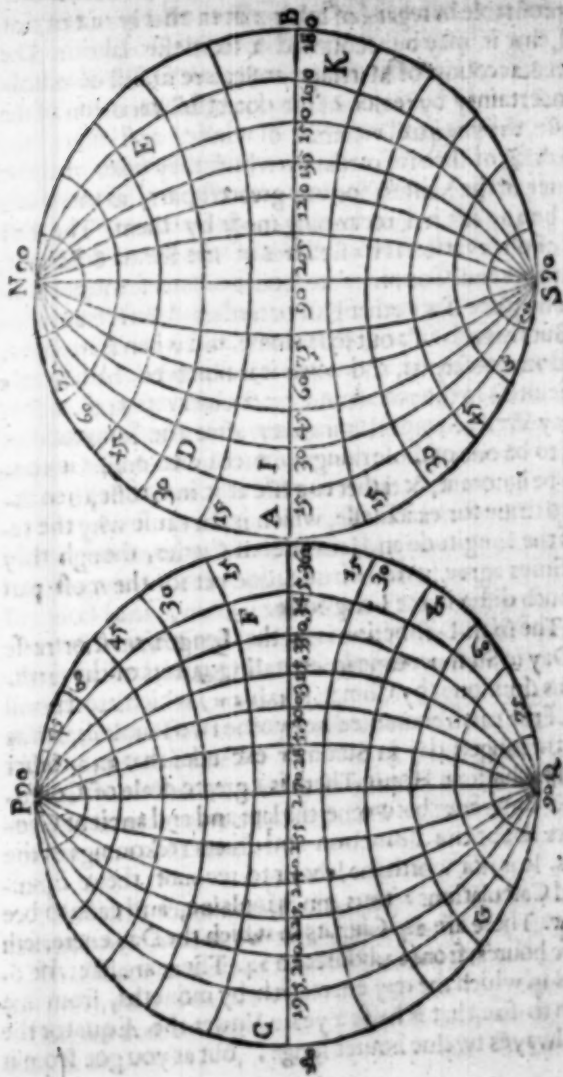
Latitude of a place, is the distance of it from the Equator towards the North or South. Whereby wee know how farre one Place lies Northward, or Southward of another.

The Longitude must bee reckoned by the degrees of the Equator, the Latitude by the degrees of the Meridian.

For example, in these two Hemispheres, the longitude of the whole earth is from (C) to (A) and (B) in the Equator. The latitud is from (N) to (S), and from (Q) to (P) the North and South poles, and this reckoned in any meridian. The first meridian is (ANBS) which goes by the Canary Ilands, the Equinoctiall is (ABCA). Now I haue a City giuen *ft.* (D) I would know in what longitude and latitude it is. For the longitude I consider what meridian passeth through it, which is the meridian (ND S) which crosseth the Equinoctiall in (I) at 15 degrees, wherefore I say that (D) stands Eastward from the first Meridian 15 degrees. So I finde that the City (E) is 150 degrees Eastward, (G) 195, and (F) 345.

For the Latitude I consider what paralell runnes through (DEG) or (E) and I finde the 30 to passe by (D) 45 by (E) the 15 by (F) the 45 Southward by (G) and those numbers are the latitude of the place, that are distant from the Equator, (CAB).

Concerning the means whereby the longitude of places is found out, there is scarce any thing that hath troubled Mathematicians so much as the observation of it. For because no standing marke can be taken (the Heavens alwaies running about) it must needs be difficult. To measure vpon the earth, going alwaies vnder the same paralell, is a way certain in regard of some few places, but so troublesome in it selfe, and



and vnprofitable in regard of other places that ly out of that paralell, that it may be accounted a fruitlesse labour. The voyages & accounts of Marriners at Sea, are so full of casualty & vncertainty by reason of the doubtfull variation of the compasse, the vnequall violence of windes and tides, the false making of their sea cards, by which they faile, and the ignorance of the Masters for the greatest part, as there can hardly be any assured, reckoning made by them. The best means of observation is by Eclipses of the Sunne & Moone, which in severall Countries are sooner or later seene, according as one place lies farther East or farther West from another. But this also falls out so seldome, and when it happens, is so seldome obserued, and when it is obserued, hath so many difficulties in the precise and exact observation of it; that wee may Well account this inquiry after the longitude of places, to be one of those things whereof wee must be content to be ignorant, & rather to gesse at it in Grosse, then in-vaine to strue for exactnesse, which is the cause why the tables of the longitude and latitude of Citties, though they many times agree in the latitude, doe yet for the most part very much differ in the Longitude.

6 The sixth Distinction is by the Length or shortnesse of the Day in Summer time in severall Quarters of the earth. And this division is by Climates (*κλίματα*) which are severall spaces of the earth contained betweene two Paralells, in the which the longest day in Summer exceeds that in another Paralell, by halfe an Houre. There is a greate deale of Confusion and difference betweene the late and ancient Geographers about the distinction and diuers reckonings of the Climates. It is not worth the labour to recount there opinions and Calculations: thus much is plaine, and easie to be knowne. There are 24. Climates in which the Day encreaseth by halfe houres, from 12. houres to 24. There are likewise 6. Climates in which the day encreaseth by moneths, from one moneth to sixe, that is halfe a yeare. Vnder the Equator the day is alwayes twelue houres longe, but as you goe from it towards

towards the Pole, the Day lengthens still till it comes to a day halfe a yeare long. Now in what degrees of latitude euery on of these Climats beginne and end, shall appeare by this table following.

7 The seaventh and last distinction of the earth is taken from the scituation of it in respect of the Heavens, and especially the Sunnes motion. In regard whereof Some parts or inhabitants of the Earth are said to be or dwell in a Right Spheare, some in a paralell Spheare, and others in an oblique or crooked Spheare.

They dwell (in *Sphæra recta*) in a right or straight Spheare who dwell iust vnder the *Æquinoctiall*, whose Horizon is paralell to the Meridians, but cutts the *Æquator* at right Angles. They dwell in paralell Spheares, who dwell iust vnder either of the Poles, whose Horizon is paralell to the *Æquator*, but cuts all the Meridians at right Angles: and the latter is sometime called a Paralell Spheare.

They dwell (in *Sphæra obliqua*) in a crooked Spheare, who inhabite any place betwene the *Æquinoctiall* and the Pole, whose Horizon cuts the *Æquator*, the Paralells, and the Meridians at oblique or vnequall angles.

1 The vse of this table is easie. In the first Columne are contained the names and number of the Climats. In the second the Paralells which enclose it on each side, and deuide it in the middelt. For the paralells here are drawne by euery halfe houres encrease.

The third Columne is the length of the Day in Summer, in euery Climate, which from 12. houres encreaseth by halfe houres to 24. houres after by moneths, from one moneth to sixe.

The fourth contains the degrees of latitude, how farre euery climate lies from the *Æquinoctiall*.

The fift containes the space or breadth of euery Climate, how many degrees or minutes it takes vp vpon the Earth.

The sixt contains some notable places by which the Climats passe.

Thole that dwell vnder the Pole haue not past 3. or 4 moneths profound as tenebras darke night, for when the Sun is in *Libra* & *Pisces* being then nigh, the Horizon it sends forth to them a glimmering light not valie to the twilight or dawning of the day in a morning a little before the Suns rising
Munster Lib. 14 cap.

2 Hereby it is easie to know what the longest Day is in any Place of the worlde whose latitude is knowne. Or contrarily the longest Day being knowne to know the latitude. For example Oxford hath latitude 52.0. degrees longitude 24.0. In the table I finde that 52. degrees of Latitude lie in the 9th Climate wherein the day is 16. houres and a halfe longe. so much I say the Day is at Oxford in Summer. The place of Oxford in the Hemisphere is at (V.)

3 Vpon Globes the Climats are not vsually described, but are noted out vpon the brazen Meridian. So also in vniuersall mappes they are seldome drawne, to auoide confusion of many lines together, but they are many times marked out on the limbe or edge of the mappe.

CAP. 6.

Of the measuring of the earth.

VVEE are now come to the last point concerning the measuring of the Earth, which is two fold, either of the

- 1 Whole earth.
- 2 Seuerall parts thereof, and their distance one from another.

Concerning the first it is but a needlesse labour to recount the diversity of opinions that haue beene held from time to time by learned Geographers, What is the compasse and depth of the earth. This may be seene in *Hues de vsu Globi*, part. 3. cap. 2. and in *Clavius* on *Sacroboſco* with others. They all differ so much one from another, that there is no certainty in trusting any of them. The most common and received opinion is that the circuit of the earth is 21600 miles, reckoning 60 miles for every degree, and then the depth or Diameter of the Earth shall be 6877 English miles, containing 5000 foote in a mile.

The means whereby the circuit and Diameter of the earth are found out are Principally two.

1 By

1 By measuring North or South, vnder one Meridian some good quantity of ground, threescore or an hundred miles (or two for the more certainty) for in those petty observations of small distances, there can be no certaine working. This may be done, though it be laborious, yet exactly without any sensible error by a skilfull workeman, plotting it out vpon his paper, with due heed taken, that hee often rectifie the variation of the needle (by which hee travells) vpon due obseruation, and that all notable ascents and descents, with such winding and turning as the necessity of the way causeth, be reduced to one streight line. By this means wee shall know how many miles in the Earth answering to a degree in the Heavens, if exact obseruation by large instruments be made to finde the elevation of the pole, in the first place where wee begin to measure, and the last where wee make an end.

Besides this way of measuring the circumference of the Earth, there is none other that hath any certainty, of obseruation in it. That by Eclipses is most vncertain, for a little error in a few minuts of time (which the observers shall not possibly avoide) breeds a sensible and sowle error in the distance of the two places of obseruation. That of *Eratosthenes* by the Sunne beames, and a shadow of a stile or gnomon set vpon the Earth, is as bad as the other. For both the vncertainty of the calculation in so small quantity as the shadow and the gnomon must needs haue, and the difficulty to obserue the true length of the shadow, as also the false supposition wherevpon it proceeds, taking those lines for Parallels which are not, doe manifestly shew the reckoning hereby made to be doubtfull and not sure.

2 The second is by measuring the semidiameter of the Earth. For as the circumference makes knowne the diameter, so doth this the circumference. This may be done by obseruation made vpon some great hill, hard by the sea side. The invention is of *Maurolycus* Abbot of *Messana* in *Sicilie*, but it hath bene perfitted, and more exactly performed

med by a worthy Mathematician *Edw.* who himfelfe made prooffe of it. By this art was the femidiameter of the Earth found out to be 18312627 foote: which allowing 5000 foot to a mile is 3662 & a halfe miles, which doubled is the whole Diameter 7325 miles. The circuit of the earth fhall be 23030 miles, and one degree containes $63\frac{61}{32}$ miles, which is almost 64 miles. Which as it exceeds the ordinary account, fo may wee reft vpon it as more exact then any other.

2 The fecond point concerninge the meafuringe of particular diftances of places one from another is thus performed.

First vpon the Globe it is moft eafie. With a payre of Compaffes take the diftance betweene any two places howfoever fituated vpon the Globe, and apply the diftance fo taken to the Equator, & fee how many degrees it takes vp, thofe degrees turned into miles fhew the diftance of the two citties one from another.

Vpon vniuerfall mapps there is a little more difficulty in findinge the diftance of places which here muft bee confidered in a threefold difference of fituation:

- 1 Of Latitude only.
- 2 Of Longitude only.
- 3 Of Latitude and Longitude together.

1 If the two places differ only in Latitude, and lie vnder the fame Meridian if the places lie both on one fide of the Equator, the differences of the latitudes: or the fomme of both latitudes added together, if one place lie North and another South, being turned into Miles giues the true diftance.

2 If the places differ only in Longitude, and lie both vnder one paralell of latitude the difference of longitude turned into miles proportionably accordinge to the latitude of the paralell giues the true diftance.

3 The diftance of places differing both in latitude and longitude may thus bee found out, firft let there bee drawne
a femi-

a semicircle vpon a right diameter noted with (*A B C D*) whereof (*D*) shall bee the Center. The greater this Semi-circle is made, so much the more easie will bee the operation; because the degrees will bee larger. Then this Semicircle being drawne, and accordingly devided, imagine that by the helpe of it, you desire to find out the distance betwixt London and Ierusalem, which Citties are knowne to differ both in longitude & latitude. Now, that the true distance betwixt these two places may be found out, you must first subtract the lesser longitude out of the greater, so shall you find the differences of their longitudes, which is 47. degrees. Then reckon that difference vpo the Semi-circle, beginning at (*A*) & so proceed to (*B*); & at the end of that difference, make a marke with the letter (*E*) vnto which point by your ruler, let a right line be drawne from (*D*) the center of the Semi circle. This being in this sort performed, let the lesser latitude be sought out which is 32 degrees, in the fore said semicircle, beginning your accompt from the point (*E*) and so proceede towards (*B*), and at the end of the lesser latitude let another point be marked out with the letter (*G*), from which point, let there be drawn a perpendicular line which may fall with right Angles vpon the former line drawn from (*D*) to (*E*), and where it chanceth to fall, there marke out a point with the letter (*H*): This being performed let the greater latitude which is 51 degrees 32 minuts, be sought out in the semicircle beginning to reckon from (*A*) towards (*B*) and at the end of that latitude set another point signed out by the letter (*I*) from whence let there be drawn another perpendicular line that may fall with right angles vpon the diameter (*A C*): & here marke out a point with the letter (*K*), this done take with your compasse the distance betwixt (*K*) and (*H*) which distance you must set, downe vpon the diameter (*A C*) placing the one foot of your compasse vpon (*K*) and the other towards the center (*D*), and there marke out a point with the letter (*L*); then with your compasse take the shorter perpendicular line (*G H*),

and apply that widenesse vpon the longer perpendicular line
 (*I K.*) placing the one foote of your compasse at (*I.*) which
 is the bounds of the greater latitude, and extend the other
 towards (*K.*) and there make a point at (*M.*) then with
 your compasse take the distance betwixt (*L.*) and (*M.*) and
 apply the same to the semicircle, Placing the one foot of
 your compasse in (*A.*) and the other towards (*B.*) & there
 marke out a point with the letter (*N.*) now the number of
 degrees comprehended betwixt (*A.*) and (*N.*) will expresse
 the true distance of the two places, which will bee
 found to be 39 degrees: which being multiplied
 by 60. and so converted into miles accor-
 ding to the former rules, will pro-
 duce 2340. which is the
 distance of the said
 places.

FINIS.
